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Priemets O. N.¹, Samoilov K. I.²

¹ International Education Corporation (KazLAACI),

² Kazakh National Research Technical University named after K. I. Satbayev (Satbaev University),
Almaty, Republic of Kazakhstan

E-mail: ¹*oksana.priemets@mail.ru*

THE SPECIFICITY OF COURSE WORKS ON "THE DESIGN OF ENERGY EFFICIENT BUILDINGS" DISCIPLINE

Abstract. The ability to interpret technological innovations in the design of buildings and structures is one of the fundamental skills of the architect. This training has a number of features, some of which are discussed in this paper by the example of performing graphical tasks on the subject of energy-efficient buildings.

Keywords: architectural design, energy efficiency, teaching methods, wind generators, solar panels, vertical gardening, sun protection, wind protection, bioclimatic architecture

Приемец О. Н.¹, Самойлов К. И.²

¹ Международная образовательная корпорация,

² Казахский национальный исследовательский технический университет имени К. И. Сатпаева,
Алматы, Республика Казахстан

E-mail: ¹*oksana.priemets@mail.ru*

СПЕЦИФИКА КУРСОВЫХ РАБОТ ПО ДИСЦИПЛИНЕ «ПРОЕКТИРОВАНИЕ ЭНЕРГОЭФФЕКТИВНЫХ ЗДАНИЙ»

Аннотация. Умение интерпретировать технологические новации в проектировании зданий и сооружений является одним из основополагающих навыков архитектора. Обучение этому имеет ряд особенностей, часть которых на примере выполнения графических заданий по тематике энергоэффективных зданий рассмотрена в данной работе.

Ключевые слова: архитектурное проектирование, энергоэффективность, методика преподавания, ветрогенераторы, солнечные батареи, вертикальное озеленение, солнцезащита, ветрозащита, биоклиматическая архитектура

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Introduction

Solving the problems of energy efficiency in the field of architectural design is an actively studied topic [1–5], which contains still a lot of poorly studied areas. One of them is a focused or spontaneous emphasis on the concept of energy-efficient architecture in the form of buildings and structures for various purposes and sizes.

In general, the very deepening of attention to the energy efficiency of buildings has led to the emergence in world practice of a large number of objects, in the form of which the corresponding techniques become to some degree a noticeable motive.

In some cases, the author's concept of energy efficiency is limited to the use of optimal thickness insulation, energy-saving or energy-generating glazing, visually in-

sulated placement of solar generators on the roof, a circulating water supply system, rainwater collection and use, built into the building's volume, installed on the roof or protruding platforms. Others emphasize the developed surfaces of vertical gardening, solar panels moving behind the sun during the day, dynamic elements of the sun- or wind-protection, large single or interlocked screws and spirals of wind generators. This has a definite impact, both on the perception of a separate object, and on the formation of urban planning complexes in general.

Approach to teaching of the design of energy efficient buildings

The practice of several years of teaching disciplines that emphasize the problem of designing energy-efficient buildings shows the appropriateness of shifting the em-

phasis from dominating the development of theoretical and calculated material (analysis of domestic and international standards for estimating building parameters, insulation thickness, quality of sealing seams, reducing heat loss, air conditioning parameters, circulating water supply, use of rainwater, feasibility studies on the use of individual techniques or integrated solution) on the formation of proper design skills practical application of appropriate techniques in the formation of facade's compositions. This is also due to the fact that the adaptation of these techniques to the traditional method of forming a volume-spatial composition is under active study and has not yet developed sufficiently clear criteria for the successful implementation of the concept.

The schedule of classes can be structured into four stages. Each stage includes three or four classes (3 academic hours each). Thematically, classes are outlined as follows: "Use of wind generators"; "The use of solar generators"; "The use of roofing and facade landscaping"; "The use of front sun and wind protection". With the allocation of four classes — the first lesson on each topic is the most illustratively rich lecture. If you plan to have three classes in each stage, then the demonstration and analysis of illustrative material are held in the process of each class. It is advisable to create an illustrative material in the electronic version (preferably available via the Internet) so that each student has the opportunity to use it independently on a personal gadget both during the lesson and during self-study.

The presentation of the material is advisable to start with historical examples of taking into account the presence, water, solar and wind activity when forming adequately to the possibilities of a favorable environment and microclimate in architectural complexes of different regions, using a set of illustrations [6]. Optimal and detailed analysis of the creation of the CSC Design Studio/Raven Run Residence headquarters, Kentucky, USA, 1975 (arch. Richard Stephen "Dick" Levin) seems to be optimal, as the first example in modern architecture of an object implementation based on the originally formulated concept of achieving maximum energy efficiency. The list of facilities for the demonstration of modern energy-efficient design techniques includes three groups: low-rise buildings, medium-rise buildings, and high-rise buildings. When analyzing examples, particular attention is paid to emphasizing either the decisions laid down in the initial draft, or the use of energy-enhancing techniques for reconstruction. An important aspect is the selection of examples of the complex use of various techniques. The optimal set of illustrations on modern domestic and world practice can be formed on the basis of a number of sources [7–11].

So, to illustrate the use of wind generators, it is advisable to demonstrate such objects as: the Exhibition pavilion EXPO-2000 "Holland creates space", Hanover, Germany, 2000 (arch. MVRDV), the Bahrain World Trade Center (BWTC), Manama, Bahrain, 2008 (arch.

WS Atkins PLC); the Residential building Strata SE1, London, UK, 2010 (arch. BFLS); the multifunctional building Pearl River Tower, Guangzhou, Guangdong, China, 2013 (arch. SOM); the Courthouse, Hamburg, Germany, 2014; the Gas station SEPSA, Adanero, Spain, 2015 (arch. Saffron Brand Consultants+Malka+Portus) and others.

The best methods of using solar generators are such objects as: Roadside supermarket, Langon, Gironde, France; "Sun Tree", San Diego, USA (arch. R. Nobl); "Parachute Sunny Flowers", Sward, Colorado, USA; Headquarters Himin Solar / Mansion of the Sun and Moon, Dezhou, China, 2009 (arch. H. Min — Himin Solar); La Seine Musicale, Paris, France, 2017 (architect S. Ban, J. de Gastines); Mosque named after Ryskeldy Kazhi, Nur-Sultan, Kazakhstan, 2018 (arch. S. Zhambulatov); Catlan Grimm School, State Island, New York, USA, 2015 (arch. SOM) and others.

To illustrate the use of roofing and facade landscaping, it is advisable to demonstrate such objects as: the US Pavilion, Milan World EXPO-2015, Milan, Italy, 2015 (arch. J. Biber — Biber Architects); La Musee Du Quay Branley, Paris, France, 2015 (arch. P. Blanc); the Multifunctional complex, Shenzhen, China, 2016 (arch. Vincent Callebaut Architects); the Pavilion, Shanghai, China, 2017 (arch. K. Kuma); the Residential building, Bagota, Colombia (arch. Paisajismo Urbano, Groncol), etc.

The use of stationary and dynamic sun and wind protection is illustrated by such objects as: Carré d'Art Exhibition Complex, Nîmes, France, 1993 (arch. N. Foster); the Quadracci Pavilion at the Milwaukee Art Museum, Milwaukee, Wisconsin, USA, 2002 (arch. S. Kalatrava); the Concert Hall "Kazakhstan", Nur-Sultan, Kazakhstan, 2010 (arch. M. Nicoletti, L. Nicoletti — Nicoletti Associati, Astanagorproekt, Mabetex Group); the Science Museum, Rio de Janeiro, Brazil, 2015 (arch. S. Kalatrava); the House of Friendship Complex, Taraz, Kazakhstan, 2016 (arch. E. Baitenov, G. Isabaev, K. Kuandykov, U. Baratov, N. Koyshanbaev, R. Bizhigitova); the Shopping center, Addis Ababa, Ethiopia, 2016 (arch. H. Vilata — Vilalta Arquitectura); the Student hostel, Mathura, India, 2017 (arch. S. Puri — Sanjay Puri Architects); the Bloomberg European headquarters, London, UK, 2017 (arch. N. Foster — Foster + Partners); Louvre Abu Dhabi/Museum of Art and Civilization, Abu Dhabi, United Arab Emirates, 2017 (arch. J. Nouvel); the Headquarters Metropol Rouen Normandy, Rouen, France, 2017 (arch. J. Ferrier — Jacques Ferrier Architecture); the Railway Station (reconstruction), Seattle, USA, 2017 (arch. Brooks + Scarpa), etc.

In the next three classes on the topic, each student, under the guidance of a teacher, graphically presents his vision of the solution of the relevant objects (it is advisable to use the student's earlier work on the discipline

"Architectural Design"). At each weekly lesson, three relevant topics of work are performed:

- low-rise buildings: 2-storey residential building (cottage or townhouse); gas station or trade pavilion; industrial warehouse pavilion;
- buildings of average number of floors: 4–6-storey residential building; shopping and entertainment complex; multi-level parking;
- high-rise buildings (number of floors 28+): residential building with service elements or a hotel; administrative office building; industrial warehouse building.

Material presentation form: A3 format with the relevant intra-university standard for framing and description (manual graphics: ballpoint-helium pen, text markers; computer graphics: ACad): plan, facade, section with axial dimensions and vertical marks in the form of diagrams with wind turbines / solar generators / roofing and front gardening / front sun- or wind-protection. As mandatory parameters, it is necessary to indicate the approximate power of generators, the area of landscaping, etc.

Delivery of works (after homework) is carried out at the next lesson in the form of comments to the submitted images and answers to related questions. Thus, in the course of mastering a course, a student performs 36 jobs per semester (9 for each of the four topics), which are stitched into an album by the end of the semester and can serve as illustrative material when taking a written or oral exam in a discipline. At the same time, it is advisable to stimulate the student to attract material with his own works in the context of international experience in answering the relevant topic.

Conclusion

The two-year experience in applying the approach outlined has shown a significant improvement in students' understanding of the problems of achieving optimal energy efficiency and the development of skills to form peculiarly artistically significant three-dimensional compositions that organically include various elements of energy efficiency in buildings and structures.

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